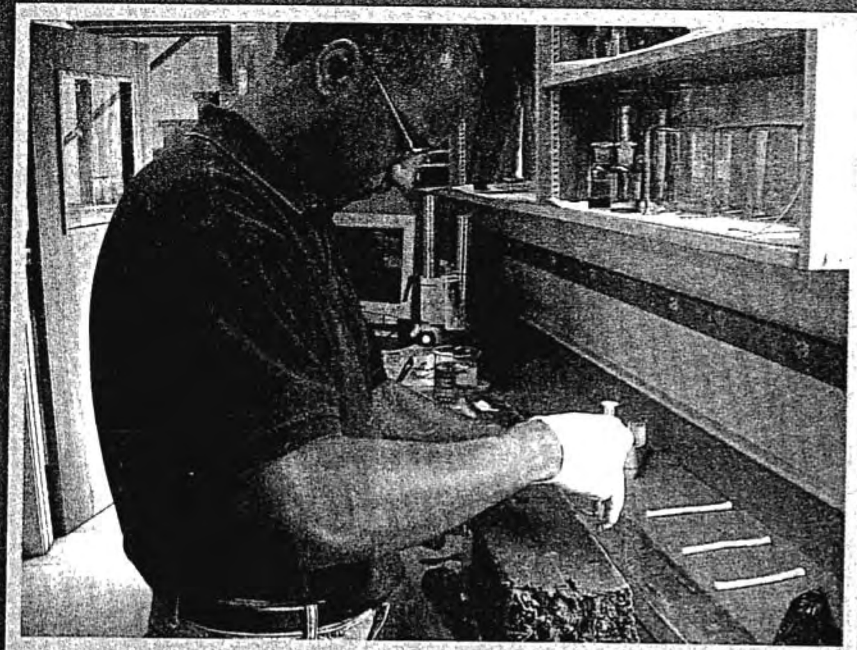

Figure 1. Dr. Vernard Lewis demonstrates the injection of thiamethoxam solution into naturally infested boards using a syringe.

THIAMETHOXAM TRIAL UPDATE

A new Neonicotinoid insecticide proves promising in the struggle against drywood termites, according to University of California, Berkeley research. By Vernard R. Lewis and Ariel B. Power

Drywood termites have considerable economic importance throughout the Sun Belt areas of North America (Su and Scheffrahn 1990, 2000, Lewis 2003). In California, drywood termites are second in economic importance behind subterranean termites (Lewis 1997). (Although, in many parts of Southern California, the drywood termite is the principal wood-destroying pest.) Local area treatments with insecticides dominate drywood termite control attempts, as much as 70 percent in California (Potter 1997, Lewis 1997). Phasing-out of obsolete active ingredients have dwindled the available active ingredients to five, down from dozens several decades ago (Lewis 2002, 2003). With con-

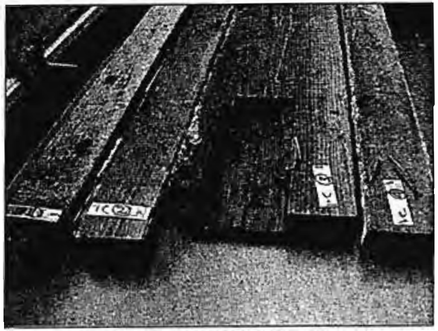

Figure 2. Sample of naturally infested boards collected from throughout California.

cerns over the safety of whole-house treatments and greater environmental awareness, new efficacious active ingredients are needed for localized drywood termite control.

MATERIALS AND METHODS. Boards containing natural infestations of drywood termites (*Incisitermes minor* Hagen) were collected from structures throughout California undergoing renovations *(see figure 2 above)*. The species of wood included Douglas fir, *Pseudotsuga menziesii* (Mirb.); Franco and redwood, *Sequoia sempervirens* (D. Don). The dimensional size of boards included 2 by 4, 2 by 10, 2 by 12 and 6 by 6 inches. Sixteen boards, each with visual signs of drywood termite damage, were selected from a storeroom (Building 476 at the Richmond Field Station, University of California, Richmond, Calif.) containing several hundred naturally infested boards.

ACOUSTICAL SEARCHING. Test boards were determined to be active with drywood termites using a termite-feeding detector. The detector determines if infestations are active by measuring acoustic emission (AE) vibrations caused when termites feed (Scheffrahn et al. 1993, Lewis 2003). The device used for the current study is marketed as Termite Tracker by Dunegan Engineering in San Juan Capistrano, Calif., and has a subsurface sensor and five sensitivity settings *(see figure 3 at right)*. Using the highest setting (level 5) three one-minute readings of termite feeding were recorded for every 45 cm of board length. Boards with an acoustic emission reading averaging four or greater for any one spot over one minute represent at least 20 live termites (Scheffrahn et al. 1993, Lewis et al. 2004) and were included in the laboratory study for localized treatment with thiamethoxam. Thiamethoxam is a new active ingredient from Syngenta Professional Products, currently being considered for registration by the Environmental Protection Agency (EPA). It is a Neonicotinoid insecticide that affects postsynaptic regions of insect nerves (Ware 2000).

Figure 3. Acoustic emission detector used to measure termite feeding activity from Termite Tracker, Dunegan Engineering, San Juan Capistrano, Calif.

APPLICATION. Application of thiamethoxam followed industry standards and procedures outlined by Scheffrahn et al. (1997) and included drilling *(see figure 4 on page 78)* and injecting all visible drywood termite kickout holes and every 45 cm of board length. (Kickout refers to small BB shot holes through which termites push their fecal pellets out of the wood.) Holes drilled for thiamethoxam applications were 2.4 mm in diameter. Starting from concentrate, three dosages of thiamethoxam (250 ppm, 500 ppm and 1,000 ppm) were prepared. The number of drilled holes, holes injected with insecticide and amount of insecticide injected were recorded. Diluted product (30 ml) was injected into each hole using a 10 ml syringe with a 16-gauge needle *(see figure 1 on page 74)*. All holes were sealed with sticky tape to minimize the spilling of liquid and escaping termites. In total, 16 infested boards were included in the study, four replicates for each dosage and four untreated boards for comparison.


Figure 4. Drilling of naturally infested boards.

POST-TREATMENT. After treatment, (April 2003) all boards were stored in the laboratory under ambient conditions for 60 days. Boards were monitored for termite activity using the AE detector at one day, one week, one month and two months post-treatment. At the conclusion of the study, all boards were dissected using hammers and chisels *(see figure 6 on page 81)* until all of the termites in every gallery and chamber in the board were extracted from the wood. Live and dead termites were counted and sorted by caste.

STATISTICAL ANALYSIS. Percent mortality was compared among treated and untreated boards using multiple sample t-test comparisons (PROC TTEST, SAS Institute 1994). Mean AE counts were transformed to counts per cubic volume of board *(see Table 1 on page 80)*. This transformation standardized AE data for all boards regardless of dimensional size or board length.

RESULTS AND DISCUSSION. Most of the field-collected boards contained live termites. Of the 16 boards used in the study, one board did not contain termites *(see table 1 on page 80)*. A second board had one termite; however 88 percent (14 of 16) of sample boards contained termites and agrees with previous studies on the detection accuracy of at least 80 percent for AE technology (Scheffrahn et al. 1993, Lewis 2003). Drywood termite colony size among sample boards varied from 1 to 852. The average colony size among boards was 195, which is comparable to colony sizes in other reports of several hundred dissected boards in California (Lewis and Haverty 2001, Lewis 2003).

For each dosage group in the thiamethoxam study, there was a good mixture of small and large colonies among boards, insuring a robust and challenging test.

INSECTICIDE AMOUNT. Considerable drilling was needed among boards to find galleries for pesticide injection *(see Table 1 on page 80)*. The number of holes drilled ranged from two to 75. However, roughly 10 percent of the total holes drilled penetrated galleries allowing for measurable amounts of pesticide. The amount of thiamethoxam injected into boards was variable, ranging from 40 to 260 ml. This treatment volume (roughly 2 to 8 ounces) falls within the range of volume commonly used for locally treating drywood termites in California.

Variables to consider when locally treating for drywood termites, including size of board, size of infestation and number and size of galleries available to inject with pesticide. AE technology was able to determine the presence and absence of live termites. However, other technologies, perhaps infrared or X-ray will be needed to more accurately determine the location of galleries. More accurately locating galleries will result in less hole drilling necessary to intersect galleries.

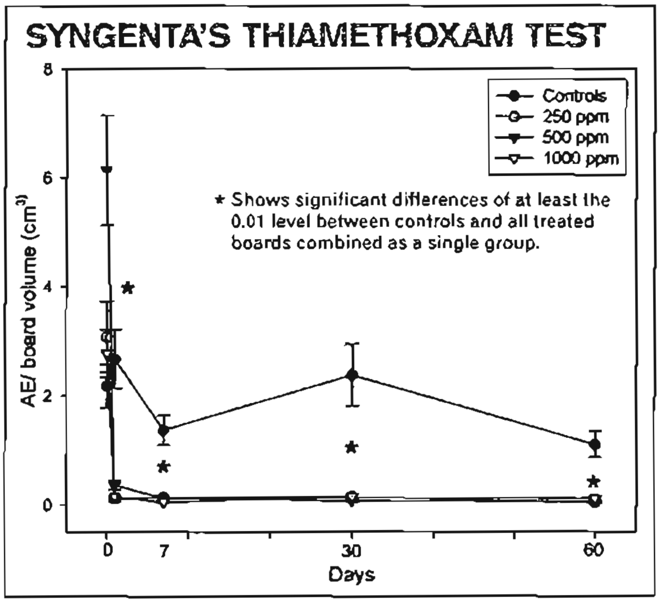

Figure 5.

EFFICACY OF THIAMETHOXAM. Treatments with thiamethoxam, irrespective of dosage, resulted in high levels of mortality for drywood termite infestations in test boards *(see figure 5 above right)*. All dosages — 250 ppm, 500 ppm and 1,000 ppm — resulted in mortality levels of 98 percent or greater *(see Table 1 below)*. After counting 2,207 termites treated with thiamethoxam, only five survivors were found. By comparison, untreated boards contained healthy termites characterized by few dead individuals and mortality level of less than 5 percent. The difference in mortality levels among treated and untreated boards was statistically significant ($t = -38.1$, $df = 3$, $P < 0.0001$). All dosages of thiamethoxam resulted in almost complete mortality of drywood termites. Perhaps lower dosages, 100 ppm or 50 ppm, should be tested for efficacy performance.

AE MONITORING. At one day after treatment there was a 90 percent drop in AE readings that measure termite feeding behavior *(see figure 5 at left)*. The drop in feeding activity continued throughout the 60-day monitoring period for boards treated with thiamethoxam. Comparing AE counts for treated and untreated boards, feeding activity in untreated boards was at least one order of magnitude greater than treated boards. This difference in AE counts per cubic volume board between treated and untreated replicates was statistically significant for all monitoring periods, one day, one week, one month and two months.

Only within the untreated board group did the mean AE level exceed four counts, per minute, per hole suggesting at least 20 live termites were continuously present (Scheffrahn et al. 1993, Lewis et al. 2004).

SUMMARY DATA

Summary data showing Thiamethoxam treatments, board statistics, amount injected, pre and post AE counts and mortality.

									AE counts					
Treatment (ppm)	Dimension (inches)	Species	Width (cm)	Length (cm)	No. AE site	Holes drilled	Holes treated	Pesticide amount (ml)	Observations Pre	Posttreatment 1-day	1-week	1-month	2-month	Mortality % (live/dead)
250	2 by 4	Doug fir	9.2	204.5	6	71	7	70	258	3	7	3	3	99% (1/88)
	2 by 12	Doug fir	28.6	123.2	3	35	2	40	581	11	53	69	11	98% (1/51)
	6 by 6	Doug fir	13.7	38.6	1	49	12	140	335	3	0	1	1	99% (3/358)
	2 by 4	Redwood	8.6	101.6	3	25	5	40	29	10	4	3	1	100% (0/159)
500	2 by 4	Doug fir	9.2	264.2	8	56	9	140	310	23	4	8	9	100% (0/40)
	2 by 4	Pine	9.2	269.2	8	75	17	250	2893	49	10	26	11	100% (0/852)
	2 by 4	Doug fir	9.2	111.8	3	38	1	25	202	66	27	0	7	No termites
	6 by 6	Doug fir	13.3	52.7	2	45	9	120	250	4	2	8	4	100% (0/267)
1000	2 by 4	Doug fir	9.2	267.9	8	72	17	220	41	28	7	8	8	Few termites (0/1)
	2 by 12	Doug fir	28.6	156.8	5	45	4	90	708	24	6	24	19	100% (0/69)
	2 by 4	Doug fir	15.9	118.7	3	12	4	90	693	19	5	23	9	100% (0/174)
	2 by 4	Doug fir	9.2	164.5	5	45	6	120	373	21	8	29	28	100% (0/143)
Untreated	2 by 10	Doug fir	23.2	208.3	6	0	0	0	122	98	76	107	70	0% (49/0)
	2 by 12	Doug fir	28.6	147.3	4	0	0	0	1101	1524	788	1569	342	8% (96/8)
	6 by 6	Doug fir	13.7	237.2	7	0	0	0	432	70	142	82	38	10% (55/6)
	6 by 6	Doug fir	13.3	110.8	3	0	0	0	1015	1313	582	889	830	<1% (700/4)

Table 1.

CONCLUSIONS. Laboratory results for thiamethoxam as a localized treatment for drywood termites were highly efficacious. The current federally registered list of active ingredients for local treatments for drywood termites is low, less than five. More are needed. Field studies will be needed to further validate the performance of thiamethoxam; however, we recommend this active ingredient be considered for EPA registration, particularly in conjunction with independent termite detection and monitoring equipment.

At the time the results of this study were released, thiamethoxam had not been submitted to the Environmental Protection Agency for use in termite control. Syngenta Professional Products has since submitted the active ingredient for approval for this use and it is currently under review at the EPA. No sale or use of thiamethoxam for termite control is permitted until all federal and state registrations have been obtained.

Figure 6. Dissection of naturally infested board using hammer and chisel.

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